

been caused by washouts on both the Central and Southern Pacific routes.

Baltimore, Md.: nearly three inches of rain fell during the storm of the 21st, and the greater part of this amount fell between 10.30 a. m. and noon. Damage to the extent of several thousand dollars was done by the flooding of sewers, etc.

Great Barrington, Berkshire Co., Mass.: the heavy rainfall on the morning of the 22d caused Green River to overflow. At Alford, in this county, a bridge was washed away; considerable damage was done at other points.

Chatham, Columbia Co., N. Y.: the rainfall on the 23d in some portions of this county was remarkably heavy. A large amount of damage was done to bridges and roadways, and in many places fields were inundated and the crops ruined.

Philadelphia, Pa.: on the 23d and 24th the heavy rainfall (about four inches) caused much damage in this city to streets and sewers.

Menands, Albany Co., N. Y.: to the east and south of Albany, destructive freshets resulted from the heavy rains which occurred during the 23d-24th, causing much damage to property. In Columbia county many dwellings were washed away.

Orange, Franklin Co., Mass.: the freshet of the 25th was the most destructive that has occurred here for many years. A number of factories had their first floors flooded.

Dover, Strafford Co., N. H., 25th: all rivers in this part of the state are unusually high. At New Market, Rockingham, Co., a part of a dam of the New Market Cotton Mill was carried away, together with some derricks and engines.

Wellsborough, Tioga Co., Pa.: on the 25th and 26th 4.15 inches of rain fell at this place; this is the heaviest rainfall that has occurred during the last eight years. Cellars were filled with water, bridges carried away, and in many places railroad tracks were washed out, causing delay of trains.

Binghamton, Broome Co., N. Y.: the heavy rains on the night of the 25-26th caused a freshet at Deposit, in this county. All of the smaller bridges in that vicinity were washed away. The water about the railroad buildings was two feet deep.

Coatesville, Chester Co., Pa.: on the 26th heavy rains caused a washout on the Pennsylvania Railroad, about half a mile west of this place. Reports from Susquehanna county state that numerous bridges in that county were washed away. At Red Rock, Luzerne Co., about two thousand feet of railroad track were washed out.

Reading, Berks, Co., Pa.: the heavy rainfall of the 26th flooded a large number of basements and cellars in this city. Numerous washouts occurred on the railroads in the surrounding country, causing delay of trains.

Greenfield, Franklin Co., Mass.: the heavy rainfall of the 26th caused a large number of washouts and land-slides between Miller's Falls and Erving, in this county.

Philadelphia, Pa.: the rainfall on the night of the 26-27th caused a large amount of damage at Falls of the Schuylkill, where, on many streets, the lower floors of houses were submerged. The damage is estimated at \$100,000. At Manayunk the streets were washed out and houses and mills were flooded.

Contoocook, Merrimack Co., N. H.: the Warren and Contoocook rivers began to overflow on the 27th. The high water at Contoocook caused partial suspension of business.

Augusta, Ga.: the heavy rains at the close of the month caused the Savannah River to rise to a height which has not been equaled since 1865; the river reached its greatest height,

34.5 feet, about 9 a. m. of the 31st and remained stationary until 3 p. m.; quantities of drift-wood were carried past the city by the rapid current, and fears were entertained for the safety of the bridges which cross the river. A considerable portion of the city was inundated, and in some places the water was ten feet deep. Travel on railroads was interrupted and the operations of mills were suspended. The rainfall on the 29th amounted to 4.50 inches, which is the largest daily rainfall on the records of the Signal Office at this place. In but three instances since 1840 has the river reached a greater height than during the freshet of July, 1887, viz.: in 1840, 37.3 feet; 1852, 36.8 feet; and 1865, 36.4 feet. During the freshet of 1864 the river reached a height of 33.8 feet.

Forsyth, Monroe Co., Ga.: from the 27th to 31st about 9 inches of rain fell at this place; this remarkably heavy rainfall was very destructive to crops in this part of the state.

Wetumpka, Elmore Co., Ala.: owing to recent heavy rains the Coosa and Alabama rivers were very high on this date. Hundreds of acres of corn land have been submerged.

Milledgeville, Baldwin Co., Ga.: the precipitation for the month, 16.09 inches, is unprecedented at this station for the month of July; the first rainy season occurred from the 4th to the 12th, when 5.75 inches of rain fell; and the second from the 27th to the 31st, when 9.98 inches of rain fell. This latter rainfall caused a freshet similar to that in 1840. Great damage was done in this county to crops, bridges, fences, etc.

#### STAGE OF WATER IN RIVERS AND HARBORS.

In the following table are shown the danger-points at the various river stations and the highest and lowest depths for July, 1887, with the dates of occurrence, and the monthly ranges:

*Heights of rivers above low-water mark, July, 1887.*

*[Expressed in feet and tenths.]*

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, La. ....	29.9	1	11.9	31	6.0	5.9
<i>Arkansas River:</i>						
Fort Smith, Ark. ....	22.0	10	7.0	26, 31	2.3	4.7
Little Rock, Ark. ....	23.0	14	6.3	31	2.4	3.9
<i>Missouri River:</i>						
Omaha, Nebr. ....	18.0	2, 3, 4	14.9	29, 31	10.3	4.6
Leavenworth, Kans. ....	20.0	2, 3	16.5	31	11.7	4.8
<i>Mississippi River:</i>						
Saint Paul, Minn. ....	14.5	20, 21, 24	2.9	31	2.3	0.6
La Crosse, Wis. ....	24.0	1, 2, 4	4.4	31	3.0	1.4
Dubuque, Iowa ....	16.0	1, 3, 4	4.5	29, 30, 31	2.7	1.8
Davenport, Iowa ....	15.0	4, 5	3.7	29, 30, 31	1.6	1.5
Keokuk, Iowa ....	14.0	7	2.9	31	1.4	1.5
Saint Louis, Mo. ....	32.0	5, 6	16.9	31	10.1	6.8
Calro, Ill. ....	40.0	5, 6, 7	16.2	31	8.8	7.4
Memphis, Tenn. ....	34.0	7	13.4	29, 30, 31	8.2	5.2
Vicksburg, Miss. ....	41.0	1	18.9	31	7.5	11.4
New Orleans, La. ....	13.0	1	7.2	29	3.2	4.0
<i>Ohio River:</i>						
Pittsburg, Pa. ....	22.0	21	6.9	30	1.5	5.4
Cincinnati, Ohio ....	50.0	1	8.1	22	4.3	3.8
Louisville, Ky. ....	25.0	1, 2	4.9	14, 24, 31	3.5	1.4
<i>Cumberland River:</i>						
Nashville, Tenn. ....	40.0	9	1.9	21, 28-31	0.9	1.0
<i>Tennessee River:</i>						
Chattanooga, Tenn. ....	33.0	10	5.6	20	1.9	3.7
<i>Monongahela River:</i>						
Pittsburg, Pa. ....	29.0	21	6.9	30	1.5	5.4
<i>Savannah River:</i>						
Augusta, Ga. ....	32.0	31	34.5	4	5.1	29.4
<i>Sacramento River:</i>						
Red Bluff, Cal. ....		1, 2, 3, 4	1.0	28, 29, 30, 31	0.6	0.4
Sacramento, Cal. ....		1, 2, 3	11.0	31	8.1	2.9
<i>Willamette River:</i>						
Portland, Oregon ....		1	23.5	31	12.5	11.0

#### ATMOSPHERIC ELECTRICITY.

##### AURORAS.

But few auroras were observed during July, and none of the displays reported were noted for brilliancy or extent of observation. The most extended displays of the month occurred on the nights of the 18-19th and 19th-20th; these were observed

principally from the Lake region eastward to the New England coast. The Signal Service observer on the summit of Mount Washington, N. H., reports: An auroral light was observed at 9.30 p. m. on the 18th, extending 20° east and west of the magnetic meridian; it very rapidly assumed the formation of an

arch, with dark segments beneath; the arch was well defined and extended to an altitude of about  $15^{\circ}$ , and azimuth  $100^{\circ}$ , while the auroral light reached an altitude of  $140^{\circ}$ . After 10.05 p. m. no streamers appeared, although the arch remained visible until daybreak on the 19th, with but little variation in brilliancy and extent. A similar display occurred the following night.

Auroras were noted on other dates, as follows:

5th, Fort Sully, Dak. 6th, Cresco, Iowa; Lansing, Mackinaw City, and Marquette, Mich.; Fort Totten, Dak.; Saint Paul, Minn. 7th, Lyons, N. Y. 12th, Egg Harbor City, N. J. 14th, Fall River, Mass. 15th, Gardiner and Eastport, Me.; Poplar River, Mont. 17th, Berlin Mills and Nashua, N. H. 18th, Windsor, Ill.; Cresco, Iowa, Eastport, and Bar Harbor, Me.; Traverse City, Mackinaw City, Marquette, Escanaba, and Alpena, Mich.; Poplar River, Mont.; Moorestown, N. J.; Northfield, Vt. 19th, Windsor, Ill.; Vevay Ind; Eastport and Bar Harbor, Me.; Lansing, Traverse City, Swartz Creek, Mackinaw City, Escanaba, and Alpena, Mich.; Poplar River, Mont.; Egg Harbor City, N. J.; Charlotte and Northfield, Vt.; Green Bay, Wis. 20th, Pekin, Ill.; Bar Harbor, Me.; Mackinaw City, Mich.; Clayton, N. J.

#### THUNDER-STORMS.

Thunder-storms are reported to have occurred in the various states and territories on the several dates as follows:

1st.—Ariz., Ark., Cal., Colo., Dak., Fla., Ill., Ind., Ind. T., Iowa, Kans., La., Me., Mass., Mich., Mo., Mont., Nebr., N. Y., Pa., Tenn., Tex., Wis., Wyo.

2d.—Ark., Colo., Dak., Fla., Ill., Ind., Ind. T., Iowa, Kans., La., Me., Mass., Mich., Mont., Nebr., N. H., N. J., N. Y., Ohio, Pa., S. C., Tenn., Tex., Vt., W. Va., Wis.

3d.—Ala., Ariz., Colo., Fla., Ga., Ill., Ind., Ind. T., Iowa, Kans., Ky., La., Mich., Mo., Nebr., N. H., N. Mex., N. Y., Ohio, Pa., S. C., Tenn., Tex., Vt., W. Va., Wis., Wyo.

4th.—Ala., Ariz., Ark., Colo., Fla., Ga., Ill., Ind., Ind. T., Kans., Ky., La., Mich., Nev., N. Mex., N. Y., Ohio, Pa., S. C., Tenn., Tex., W. Va.

5th.—Ala., Ariz., Ark., Cal., Col., Fla., Ga., Ill., Ind., Ind. T., Kans., Ky., La., Md., Mass., Mich., Miss., Nebr., Nev., N. J., N. Y., Ohio, Oregon, Pa., S. C., Tenn., Tex., Va.

6th.—Ala., Ariz., Ark., Conn., Dak., Fla., Ga., Ill., Ind., Ind. T., Kans., Ky., La., Md., Mass., Miss., Mont., N. J., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C., Tenn., Tex., Vt., Va., Wash., W. Va., Wyo.

7th.—Ariz., Colo., Dak., Fla., Ga., Ill., Ind., Ky., La., Mass., Miss., Mo., Mont., Nebr., N. H., N. Y., N. C., Pa., R. I., S. C., Tenn., Tex., Va., Wyo.

8th.—Ala., Ariz., Cal., Colo., Dak., Fla., Ill., Ind., Iowa, Kans., Ky., La., Mich., Minn., Miss., Nebr., N. J., N. C., Ohio, S. C., Tenn., Tex., Va., Wis.

9th.—Ala., Ariz., Ark., Cal., Colo., Conn., Dak., D. C., Fla., Ga., Ill., Ind., Ind. T., Iowa, Kans., Ky., Md., Mass., Mich., Miss., Nebr., Nev., N. H., N. J., N. C., Ohio, Pa., R. I., Tenn., Tex., Utah, Vt., Va., W. Va., Wis., Wyo.

10th.—Ala., Ariz., Ark., Colo., Conn., Dak., Fla., Ga., Idaho, Kans., La., Me., Mass., Miss., Mont., Nebr., Nev., N. J., N. C., Pa., R. I., S. C., Tenn., Tex., Utah, Wyo.

11th.—Ala., Ariz., Ark., Colo., Dak., Fla., Ga., Ill., Iowa, Kans., La., Mass., Minn., Mont., Nebr., N. Mex., N. C., S. C., Tenn., Tex., Wis., Wyo.

12th.—Ala., Ariz., Ark., Colo., Dak., Fla., Ga., Ill., Ind. T., Iowa, Kans., La., Mich., Miss., Mo., Mont., Nebr., S. C., Tenn., Tex., Utah, Wis.

13th.—Ala., Ariz., Ark., Colo., Dak., Fla., Ga., Ind. T., Iowa, Kans., La., Mich., Miss., Mont., Nebr., Ohio, Pa., S. C., Tenn., Tex., Wis.

14th.—Ala., Ariz., Ark., Col., Dak., D. C., Fla., Ill., Ind. T., Kans., Ky., La., Mass., Minn., Miss., Nebr., N. J., N. C., Ohio, Tenn., Tex., Utah, Va., Wis., Wyo.

15th.—Ala., Ariz., Ark., Col., Dak., Fla., Ind. T., Kans., Minn., Mont., Nebr., N. Y., N. C., Ohio, Pa., Tenn., Tex., Utah, Va., Wyo.

16th.—Ala., Ark., Colo., Conn., Dak., Fla., Ga., Ill., Iowa, Kans., Md., Mass., Mich., Minn., Mont., Nebr., N. H., N. J., N. Y., Ohio, Pa., S. C., Tex., Utah, Va., Wis.

17th.—Ala., Ariz., Colo., Conn., Dak., D. C., Fla., Ill., Ind., Ind. T., Iowa, Kans., Ky., La., Md., Mass., Mich., Mont., Nev., N. J., N. Y., N. C., Ohio, Pa., R. I., S. C., Tenn., Tex., Va., Wis., Wyo.

18th.—Ala., Ark., Colo., Conn., Dak., D. C., Fla., Ga., Ill., Ind., Ind. T., Iowa, Kans., Ky., La., Md., Mass., Minn., Nev., N. J., N. Mex., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C., Tenn., Tex., Utah, Va., W. Va., Wis., Wyo.

19th.—Ala., Ark., Cal., Colo., Dak., D. C., Fla., Ga., Ill., Ind., Kans., Md., Mich., Minn., Miss., Nebr., N. J., N. C., Ohio, Pa., S. C., Tenn., Va., W. Va., Wyo.

20th.—Ala., Ark., Colo., Dak., Fla., Ga., Ill., Ind. T., Iowa, Kans., La., Miss., Mo., Mont., Nebr., N. C., Ohio, Pa., S. C., Tenn., Tex., Va., Wash., W. Va., Wyo.

21st.—Ala., Ark., Colo., Conn., Dak., D. C., Fla., Ga., Ill., Ind., Iowa, Kans., Ky., La., Md., Mich., Minn., Miss., Mo., Mont., Nebr., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Tex., Va., Wash., Wis., Wyo.

22d.—Ala., Ark., Colo., Conn., Fla., Ga., Ill., Ind., Ky., La., Md., Mich., Miss., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Texas, Vt., Va., Wash., Wyo.

23d.—Ala., Ariz., Ark., Conn., Dak., D. C., Fla., Ga., Idaho, La., Me., Md., Mass., Mont., Nebr., N. H., N. J., N. Y., N. C., Pa., S. C., Tenn., Texas, Va., Wash.

24th.—Ala., Ariz., Ark., Colo., Conn., Dak., D. C., Fla., Ga., Ind., Ky., La., Me., Md., Mass., Minn., Miss., Mont., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Texas, Va., Wash., W. Va.

25th.—Ala., Ariz., Ark., Colo., Dak., D. C., Fla., Ga., La., Me., Md., Minn., Mont., Nebr., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Texas, Va., Wash., W. Va.

26th.—Ala., Ark., Colo., Conn., Dak., D. C., Fla., Idaho, Ind., Kans., Ky., La., Md., Mass., Minn., Mont., Nebr., N. J., N. Y., N. C., Pa., S. C., Tenn., Va., W. Va., Wis.

27th.—Ark., Cal., Colo., Conn., Dak., D. C., Fla., Ga., Ill., Ind., Iowa, Kans., Md., Mass., Mich., Minn., Nebr., N. H., N. J., N. Y., N. C., Ohio, Oregon, Pa., Tenn., Texas, Va., Wis., Wyo.

28th.—Ariz., Ark., Cal., Dak., Fla., Ga., Idaho, Ill., Ind., Iowa, Me., Mass., Minn., Mont., Nebr., N. H., N. Y., N. C., Ohio, Oregon, S. C., Tenn., Texas, Vt., Va., Wis., Wyo.

29th.—Ala., Ariz., Ark., Colo., Conn., Dak., Fla., Ga., Iowa, La., Me., Mass., Mich., Minn., Nebr., N. H., N. J., N. Y., N. C., Pa., S. C., Tenn., Texas, Vt., Va., W. Va., Wis.

30th.—Ala., Ariz., Ark., Colo., Fla., Ga., Ill., Ind. T., Iowa, Kans., Me., Mich., N. H., N. J., N. Y., Ohio, Pa., S. C., Texas, Vt., Va., W. Va., Wis.

31st.—Ark., Colo., Conn., Dak., Fla., Ga., Ill., Ind., Kans., Ky., Me., Md., Mass., Minn., Mont., Nebr., N. J., N. Y., N. C., Ohio, Oregon, Pa., R. I., S. C., Tenn., Texas, Vt., Va., Wyo.

#### OPTICAL PHENOMENA.

##### HALOS.

1st-6th.—Lunar halos were quite numerous in the states to the south of the Ohio and east of the Mississippi Rivers during this period, while a few solar halos were observed in the districts to the northward. These halos were noted during

the passage of the area of low pressure, described as number i., from the middle Rocky Mountain slope to the Saint Lawrence Valley.

7-24th.—During this interval lunar halos were reported from but four stations, viz., Vevay, Ind., 7th; Erie, Pa., 8th;